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Paleontological records indicate the occurrence of open woodlands in a dry inland climate at the present-day Arctic coast in western Beringia during the Last Interglacial

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ABSTRACT

Permafrost records, accessible at outcrops along the coast of Oyogos Yar at the Dmitry Laptev Strait, NE-Siberia, provide unique insights into the environmental history of Western Beringia during the Last Interglacial. The remains of terrestrial and freshwater organisms, including plants, coleopterans, chironomids, cladocerans, ostracods and molluscs, have been preserved in the frozen deposits of a shallow paleolake and indicate a boreal climate at the present-day arctic mainland coast during the Last Interglacial. Terrestrial beetle and plant remains suggest the former existence of open forest-tundra with larch (*Larix dahurica*), tree alder (*Alnus incana*), birch and alder shrubs (*Duschekia fruticosa, Betula fruticosa, Betula divaricata, Betula nana*), interspersed with patches of steppe and meadows. Consequently, the tree line was shifted to at least 270 km north of its current position. Aquatic organisms, such as chironomids, cladocerans, ostracods, molluscs and hydrophytes, indicate the formation of a shallow lake as the result of thermokarst processes. Steppe plants and beetles suggest low net precipitation. Littoral pioneer plants and chironomids indicate intense lake level fluctuations due to high evaporation. Many of the organisms are thermophilous, indicating a mean air temperature of the warmest month that was greater than 13 °C, which is above the minimum requirements for tree growth. These temperatures are in contrast to the modern values of less than 4 °C in the study area. The terrestrial and freshwater organism remains were found at a coastal exposure that was only 3.5 m above sea level and in a position where they should have been under sea during the Last Interglacial when the global sea level was 6–10 m higher than the current levels. The results suggest that during the last warm stage, the site was inland, and its modern coastal situation is the result of tectonic subsidence.

1. Introduction

The high latitudes are expected to be particularly affected by global warming (ACIA, 2005; ACIS, 2008). Warming in the Arctic is amplified by positive feedback processes, such as decreasing albedo due to temporarily and spatially reduced sea ice and snow cover as well as greenhouse gases released from melting permafrost (Schuur et al., 2009; Screen and Simmonds, 2010). Another consequence might be the presumed northward shift of vegetation zones as is already indicated by expanding shrub vegetation (Stow et al., 2004; Tape et al., 2006), resulting in additional albedo changes that amplify arctic summer warming (Chapin et al., 2005). The biotic response to climate change is hardly predictable. Tree line advance, for example, is dependent on global temperature alterations, tree and shrub species characteristics and local environmental conditions (Danby and Hik, 2007). A suggested key factor is soil moisture. Global warming is possibly associated with increasing cloud cover and humidity in certain northern regions (Vavrus et al., 2009). Increased moisture may cause paludification, which in turn may decrease the

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